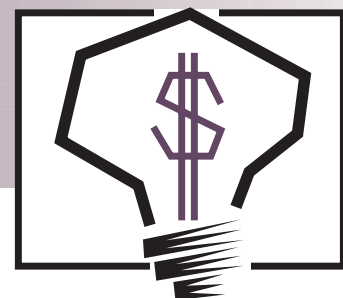


INVENTIONS & INNOVATION

Success Story



NIGHTSKY – A NEW ROOFING TECHNOLOGY

New Natural Evaporating Roofing/Cooling System Can Double a Roof's Life Expectancy and Reduce Cooling Loads

Benefits

- ◆ Has saved over 1.4 billion Btu cumulatively through 2000
- ◆ Reduces energy required for cooling 50% to 90%
- ◆ Can result in demand charge savings of 50% to 70% because of off-peak energy consumption
- ◆ Has saved \$20,000 in energy purchases through 2000
- ◆ Extends roof and cooling system life
- ◆ Reduces roof maintenance with the automatic cleaning functionality
- ◆ Has avoided 100 tons of CO₂ emissions through 2000
- ◆ Improves a building's fire protection by supplying an on-site water reservoir and by providing a large thermal mass

Applications

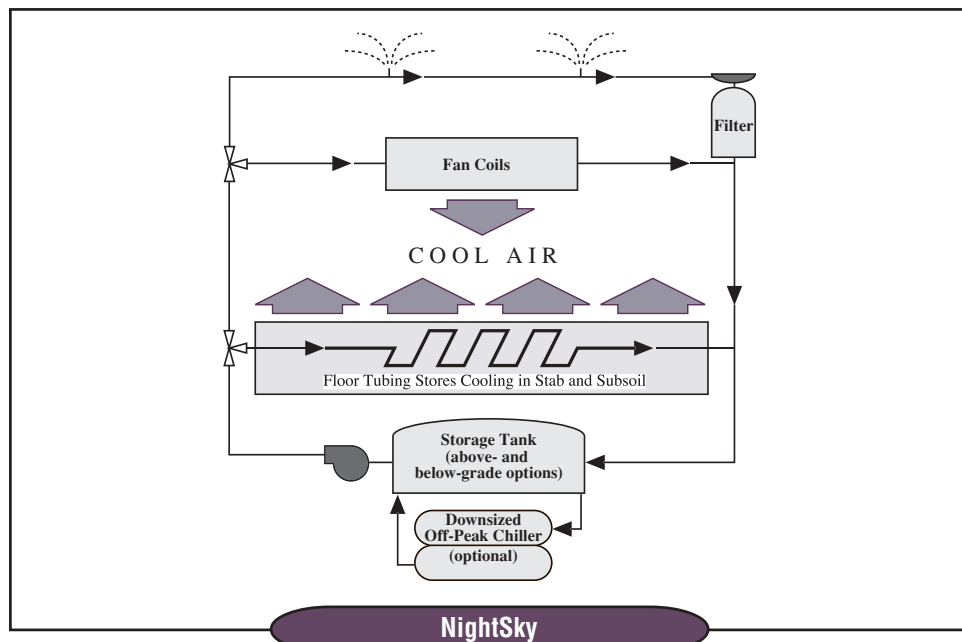
For flat or slope roofed commercial buildings.

Capabilities

- ◆ Has options for use as an evaporative cooler, precooling tower, or water-cooled condenser
- ◆ Can store water above or below ground

The sun's heat on a conventional flat roof plays a large part in the failure of a roof system and the increased cooling load in a building. In one day, a dry roof can cycle from a few degrees below the lowest night temperature up to 180° Fahrenheit. Recent surveys by the National Roofing Contractors Association indicate that more than 45% of new roofs completed by their members experienced structural problems in the first five years of service. Further, by controlling a building's radiative heat transfer through the roof, space cooling loads can be cut in half. Technologies for inhibiting heat energy gained through the roof include roof wetting, increased insulation, roof shading, radiant barriers, and highly reflective paints or coatings. Of these technologies, only a few can keep out water while also blocking out the sun's heat.

With the aid of a grant from the U.S. Department of Energy's Inventions and Innovation Program, Richard Bourne developed the NightSky, a unique roofing/cooling system that not only provides protection from outdoor conditions but increases cooling energy savings. This unique innovation allows owners of commercial one-story flat roofed buildings the ability to double a flat roof's life expectancy and cut cooling loads by at least 50%. The NightSky system is also applicable to low-rise buildings and low-sloped roofs. With NightSky, roofing and cooling problems can now be solved simultaneously.



Technology Description

This innovation spray-cools water on the roof at night and applies the cooled water to reduce subsequent cooling loads. On clear nights, the sky is much colder than outdoor air, contributing to high water cooling rates through a combination of evaporation and sky radiation. Overnight, NightSky systems can typically cool a large storage volume (preferably two gallons per square foot of roof surface) to a final temperature as much as 12 degrees below the minimum night air temperature.

The original NightSky version uses a water-ballasted protected-membrane roof on a "dead level" structure. The three-inch water layer is covered with 4- to 8-inch-thick insulation panels that keep the water cool through daytime heat. This version can directly cool the building by conduction downward through the roof, or the naturally cooled water may be circulated for controlled delivery through fan coils or radiant surfaces. Also, the cool roof deck eliminates roof cooling loads. A second NightSky version works with conventional sloping roofs, capturing the spray-cooled water at roof drains for return to a water storage tank. From the tank, which can double as thermal storage for an "off-peak" auxiliary cooling system, chilled water is circulated to cooling delivery components. Both versions include water filters with automatic backwash, automatic water refill, and micro-processor controls that optimize the spray cooling cycle and integrate with cooling delivery components.

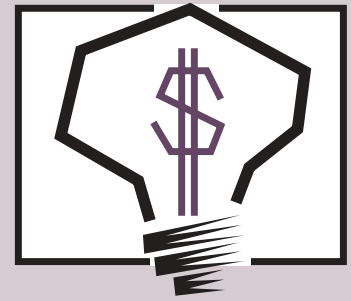
Energy Savings and System Economics

Independent monitoring of five completed commercial NightSky systems verify cooling efficiencies five to fifteen times higher compared with conventional cooling systems. These systems can reduce peak cooling demand by 50% to 90%. By reducing the size and cost of conventional cooling components, they can frequently be installed with paybacks of three years or less in new building applications or less than five years on existing buildings when chillers or rooftop units are being replaced. Cumulative energy savings through 2000 have surpassed 1.4 billion Btu. The associated reduction in CO₂ emissions is estimated to be 100 tons, and avoided energy purchases total \$20,000.

The NightSky system has significant economic potential to new building owners, while helping utilities reduce demand electricity loads. The system has a better payback when incorporated into new construction but will still provide significant energy savings for re-roofing/retrofit applications. The NightSky won ASHRAE's Western Region (Region X) Technology Award in 1999 and is protected under U.S. Patent number 5,174,128.

INVENTIONS AND INNOVATION PROGRAM

The Inventions and Innovation Program provides financial assistance for establishing technical performance and conducting early development of innovative ideas and inventions. Ideas that have a significant energy-savings impact and future commercial market potential are chosen for financial support through a competitive solicitation process. Inventions funded by the program have saved enough energy to light 10 million homes per year. In addition, the program offers technical guidance and commercialization support to successful applicants. Ideas that benefit the Industries of the Future, designated by the Office of Industrial Technologies as the most energy-intensive industries in the United States, are especially encouraged.



"DOE support has been essential to refining the NightSky system and enhancing its credibility in the marketplace."

— Richard Bourne
NightSky System Inventor

For project information, contact:

Paul Passantino
Integrated Comfort, Inc.
3811 Dividend Drive
Suite D
Shingle Springs, CA 95682
Phone: (530) 672-8402.
Fax: (530) 672-2518
paulpas@pacbell.net

For more information about the
Inventions and Innovation Program,
contact:

Lisa Barnett
Program Manager
Inventions and Innovation Program
U.S. Department of Energy
1000 Independence Avenue SW
Washington, D.C. 20585-0121
Phone: (202) 586-2212
Fax: (202) 586-7114
lisa.barnett@ee.doe.gov

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